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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/026,286	12/20/2001	Yoshiaki Mori	P6495a	1796

20178 7590 01/23/2008

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EXAMINER	
CHACKO DAVIS, DABORAH	
ART UNIT	**PAPER NUMBER**
1795	

MAIL DATE	DELIVERY MODE
01/23/2008	PAPER

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BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

Application Number: 10/026,286
Filing Date: December 20, 2001
Appellant(s): MORI ET AL.

Rosalio Haro
For Appellant

EXAMINER'S ANSWER

This is in response to the appeal brief filed November 2, 2007, appealing from the Office action mailed October 18, 2006.

(1) Real Party in Interest

A statement identifying by name the real party in interest is contained in the brief.

(2) Related Appeals and Interferences

The examiner is not aware of any related appeals, interferences, or judicial proceedings which will directly affect or be directly affected by or have a bearing on the Board's decision in the pending appeal.

(3) Status of Claims

The statement of the status of claims contained in the brief is correct.

(4) Status of Amendments After Final

The appellant's statement of the status of amendments after final rejection contained in the brief is correct.

(5) Summary of Claimed Subject Matter

The summary of claimed subject matter contained in the brief is correct.

(6) Grounds of Rejection to be Reviewed on Appeal

The appellant's statement of the grounds of rejection to be reviewed on appeal is correct.

(7) Claims Appendix

The copy of the appealed claims contained in the Appendix to the brief is correct.

(8) Evidence Relied Upon

EP 0630044	Okumura et al., hereinafter referred to as Okumura	12-1994

(9) Grounds of Rejection

The following ground(s) of rejection are applicable to the appealed claims:

Claim Rejections - 35 USC § 102

1. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

2. Claims 1-22, are rejected under 35 U.S.C. 102(b) as being anticipated by EP 0630044 (Okumura et al., hereinafter referred to as Okumura).

Okumura, in the abstract, in col 2, lines 24-57, in col 3, lines 14-58, in col 4, lines 1-56, discloses a pattern forming method of forming a mask having pattern forming openings (photolithographically formed photoresist pattern, reference 43, of figures 4A through 4D), immersing the substrate with openings to a predetermined solution to fill the opening with the material (solidified liquid pattern material, drying the liquid solution adhered onto the opening so as to form a layer in the opening, the SOG layer or SiO_2 layer is solidified, palladium layer (electrically conductive layer) formed in the openings), removing by etching the material adhered onto portions of the surface of the photoresist mask (not the material formed in the opening), performing a hydrophobic treatment (photoresist mask is also made hydrophobic), performing a baking treatment, immersing the substrate again to form another layer of the material in the openings (plural pattern material supply process, solidifying the material to form a layer, forming another solid

glass layer), performing a photoresist mask removal process by ashing (including annealing, i.e., mask removal and annealing is performed simultaneously). Okumura, in col 2, lines 42-46, and in col 4, lines 34-56, discloses that photoresist pattern mask is hydrophobicized prior to forming the liquid material in the openings, and the removal process of material attempting to adhere on the mask surface is accomplished due to the imparted hydrophobicity (i.e., the surface of the photoresist mask will repel or dissipate in the solution or while removed the liquid material attempting to and/or adhered to the mask surface (while being immersed or removed out of the solution for further processing) (claims 1-22).

(10) Response to Argument

Section 1

Claims 1, 10, 11, 12, 13, 14, 15

A) Appellant argues that Okumura does not show solidifying a solution by means of a first heat dry step followed by an annealing step.

The claims do not recite solidifying a solution. The claims recite solidifying an electrically conductive liquid pattern material in the pattern forming openings of the mask, and not solidifying a solution. Claims 1, 10, 11, and 14-15, do not recite solidifying using a first heat-dry step followed by annealing. Claims 12-13, recite that a heating step that comprises a drying process for evaporating solvent in the liquid pattern material and an annealing process for annealing the dried solute. Okumura, in col 4, lines 44-53, discloses immersing substrate with a mask i.e., a photoresist mask that has

pattern forming opening (unmasked portions are the pattern forming openings), see below,

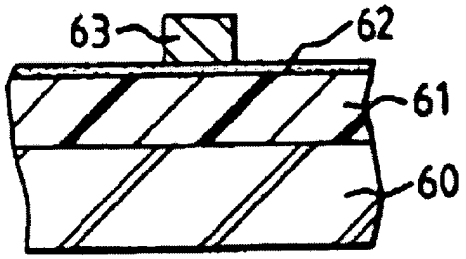

FIG.6A

and immersing the substrate with the mask into a solution of palladium chloride to form a palladium layer i.e., solution of palladium chloride is applied on to the mask formed side of the substrate such that palladium layer is formed on the surface of the mask and the unmasked portions; the layer formed is no longer a solution, the process of forming the palladium layer inherently included a drying process since the layer formed is not a liquid and since the layer is not a palladium chloride solution, it is a solidified layer. The substrate (that was immersed in palladium chloride layer to form palladium layer) is then subjected to plasma ashing to remove the mask portions, ashing process itself raises the temperature of the substrate i.e., it undergoes annealing.

B) Appellant argues that SiO_2 is an insulator and not a conductor.

See paragraph A) above. The material formed in the openings is a palladium layer, and palladium layer is an electrically conductive layer.

C) Appellant argues that the solution is not solidified, and that it remains in a solution form even after formation of the SiO_2 layer.

The solidification process is discussed in paragraph A). However, Okumura, in col 3, lines 20-25, see below,

formed by, e.g., sputtering. Then, a patterned photoresist pattern 43 of about 12,000 A is formed on the A1 layer 42 using a conventional exposure and development technique. Next, a glass layer 44 is formed by a Spin on Glass (SOG) method following a baking treatment. (FIG. 4A) Then, a conventional etching process is carried out to remove the relatively thin glass layer formed on the photoresist 43, and to leave a portion of the relatively thick glass layer 44 formed where the photoresist layer 43 is not formed. Next, a hydrophobic treatment is

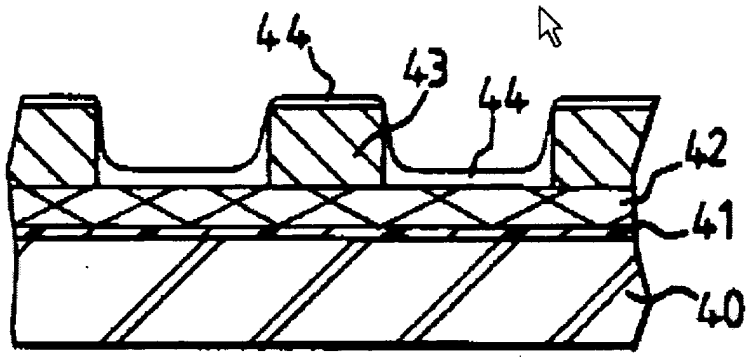

FIG. 4A

discloses the formation of a glass layer on a substrate that has a mask pattern (reference 43), wherein the glass layer is formed in the pattern forming openings (reference 44). The glass layer formed is not a liquid, it is a solid. It is a glass layer.

D) Appellant argues that Okumura does not disclose that his aqueous solution is solidified by drying the solution to precipitate a dried solute, that is subsequently annealed into a high quality solid trace.

As discussed in paragraph A) the claims recite solidifying an electrically conductive liquid pattern material in the pattern forming openings. This is discussed in paragraph A). The solution into which the substrate is immersed is a palladium chloride solution. The palladium layer formed in the openings is not a solution, it is a layer and is a solid, and is conductive. It is later heated (during an ashing process, i.e., it is annealed). The limitation argued viz., annealed into a high quality solid trace is not a claim limitation.

E) Appellant argues that Okumura's SOG process does not read on the liquid pattern material of the present invention and that it is not solidified as claimed, it is an insulator, not a conductor, not precipitation of dried solute from the glass by evaporation; Okumura does not teach or suggest an SOG process where the glass is distributed within a mask, and that the glass is annealed after the mask is removed.

These arguments have been addressed in paragraph A) and C).

F) Appellant argues that palladium layer is formed by electroless plating and is not equivalent to solidifying a liquid pattern material.

The claims recite solidifying a liquid pattern material in the pattern forming openings. The process i.e., how the liquid pattern material is solidified in the openings, or what type (other than the pattern material formed being conductive) of liquid pattern material is applied in the pattern forming openings is not recited in the claims. Okumura discloses immersing a substrate with a resist mask formed on it (and has pattern forming openings) into a palladium chloride solution and forming in the openings a

palladium layer. This palladium layer is no longer a solution, it is a solid layer i.e., inherently dried. Additionally, Okumura, in col 4, lines 47-50, discloses,

> plating method. Next, the substrate is immersed into a mixed solution of nickel sulfate (NiSO4) and hypophosphite to form a nickel layer **65** of about 1000 Å. **(FIG.6B)**

the substrate with the photoresist mask and pattern forming openings, is immersed in a solution of nickel sulfate and hypophosphite to form a nickel layer in the openings. The formation process does not include a plating process. Whether the layer formed in the openings used a plating or a non-plating method is irrelevant because the claim does not recite a particular deposition process or a particular forming process. The liquid material i.e., the palladium chloride solution or the of nickel sulfate and hypophosphite solution is the material into which the substrate with the pattern forming openings is immersed. The solution no longer remains in the openings. The material formed in the openings is a solid layer viz., palladium layer or nickel layer, that has inherently undergone a drying process, i.e., it is solidified.

G) Appellant argues that Okumura does not disclose supplying and solidifying an electrically conductive liquid pattern material in pattern forming openings of the mask.

Okumura, in col 4, lines 44-50, discloses supplying a liquid pattern material, and teaches that the liquid pattern material formed in the mask openings are electrically conductive, and is in solid form. The palladium layer (also nickel layer) formed in the openings have a definite form and volume, and the palladium layer or the nickel layer is not flowing out of the openings and is therefore a solid. Also see paragraph A), and D).

H) Appellant argues that Okumura does not disclose that the liquid pattern material is solidified by applying heat.

The claims recite that the heat is applied by a drying process that evaporates the solvent. Okumura, in col 4, lines 35-50, discloses the formation of the palladium layer and nickel layer in the pattern forming openings, the substrate is not left in the solution immersed after forming the conductive layer in the openings. The substrate is removed and the solvent particles are evaporated via drying, since the layer formed in the openings are not in a solution form, it is a solid layer.

I) Appellant argues that Okumura does not disclose that the liquid pattern material is solidified after removing liquid pattern material adhered to the mask surface when the liquid pattern material was supplied to the pattern forming openings.

Okumura discloses, in col 4, lines 35-50, the application of the liquid pattern material in the mask openings and the formation of the palladium and nickel layers (references 64, and 65),

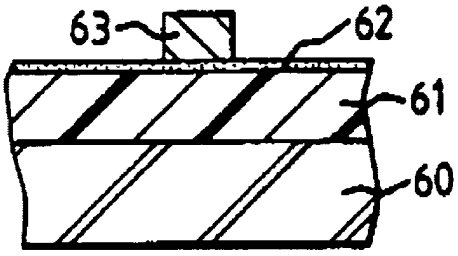

FIG.6A

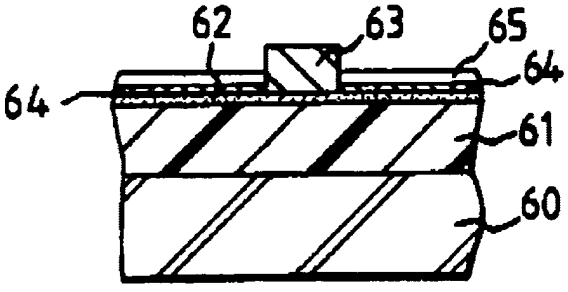

FIG.6B

wherein the mask surface (reference 63, side surface of the mask, both sides have the pattern forming material particles adhered to the mask side surface) adjacent to the

palladium and nickel layer is removed, while the palladium and nickel layer formed in the openings remain solidified (see below).

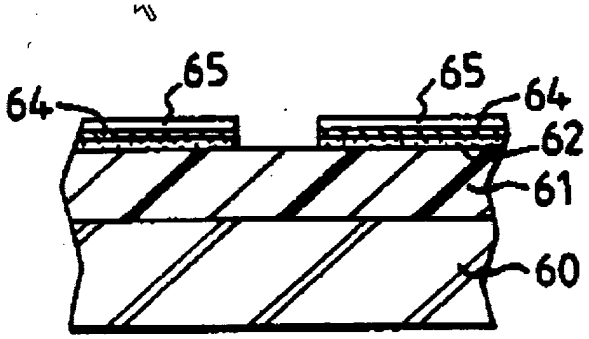

FIG.6C

The claim i.e., claim 15, does not recite that the solidification is performed by heating or drying, it merely recites solidified. The palladium and nickel layer pattern (references 64, and 65) are of definite shape and volume and is solidified.

Section 2

Claims 2, 18

A) Appellant argues that Okumura does not teach that the liquid-pattern material is dried while it is being supplied to the pattern forming openings of the mask.

Claim 2, recites,

2. A pattern forming method comprising:

a mask forming process for forming a mask having pattern-forming openings on a workpiece surface;

a pattern material supplying process for supplying a liquid-pattern material to the pattern-forming openings while also drying the liquid-pattern material;

a process for removing the mask from the workpiece; and

an annealing process for annealing dried solute of the liquid-pattern material.

The claim (claim 2) does not recite that the liquid pattern material is dried while it is being supplied. The claim limitation is, "supplying a liquid pattern material to the pattern forming openings while also drying the liquid pattern material". This is interpreted as the liquid pattern material formed in the openings is being dried. The limitation "while also drying the liquid pattern material" is interpreted as the liquid pattern material formed in the openings of the mask, and is not interpreted as the liquid pattern material during the supplying process, wherein the pattern material has not reached the surface of the openings in the mask. As discussed in Section 1, paragraph G), and H), Okumura teaches forming the liquid material in the openings of the mask, and drying the material formed in the opening i.e., the layer in the opening is no longer in liquid form, it is a solid.

Section 3

Claim 3

A) Appellant argues that Okumura does not teach a drying process for evaporating the solvent in the liquid-pattern material, and that Okumura does not teach an annealing process for annealing dried solute in the liquid pattern material.

Okumura, in col 4, lines 35-53, discloses that the photoresist mask covered substrate is immersed in a palladium chloride solution so as to fill the unmasked portions (i.e., pattern-forming openings) with palladium, and that the layer formed in the openings is a palladium layer, wherein the palladium is no longer in its solution form, it has undergone drying and none of the solvent from the solution remains in the openings, and the layer formed in the openings is a solid palladium layer that has inherently (during the process of forming) evaporated all the solvent particles, and formed a solid layer; Okumura further teaches that the photoresist mask is removed by ashing using an oxygen plasma, wherein during, and immediately after an ashing process the substrate and the layers that are formed therein undergo an inherent heating treatment (an increase in temperature) i.e., the palladium layer, reference 64 (and nickel layer, reference 65) formed in the openings are subjected to an annealing treatment. See figure 6C below,

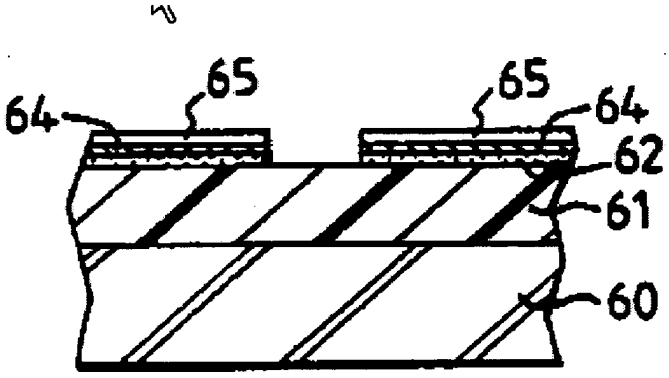

FIG.6C

Section 4

Claim 4

A) Appellant argues that Okumura does not disclose supplying an electrically conductive liquid pattern material to the pattern-forming openings, and that Okumura's plating process does not read on claimed step of solidifying of liquid-pattern material.

This is addressed in Section 1, arguments F), and G), and in Section 3.

Section 5

Claim 5

A) Appellant argues that Okumura does not teach an adherent liquid removal process for removing liquid pattern material that adhered to the mask surface when the liquid was supplied to the openings before solidifying the liquid-pattern material.

Claim 5, recites

5. A pattern forming method comprising:

a mask forming process for forming a mask having pattern-forming openings on a workpiece surface;

a pattern material supplying process for supplying a liquid-pattern material to the pattern-forming openings;

an adherent-liquid removal process for removing liquid pattern material that adhered to the mask surface when the liquid-pattern material was supplied to the openings;

a drying process for drying by evaporating solvent from the liquid-pattern material in the pattern-forming openings;

an annealing process for annealing the dried solute after sequentially performing plural times the pattern material supply process, adherent-liquid removal process, and drying process; and

a mask removal process for removing the mask from the workpiece.

Claim 5, does not recite that the adherent liquid removal process is performed prior to a solidifying process. Okumura, in col 2, lines 42-46, and in col 4, lines 34-56, discloses that the photoresist mask top surface is hydrophobicized prior to forming the liquid or solution in the openings, and then the substrate with the resist mask is completely immersed in the solution i.e., liquid is applied onto to the entire surface and that includes the top surface of the mask. However, the material attempting to adhere and/or nucleate on the surface of the mask is repelled or dissipated into the tank, i.e., the adherent liquid is removed from the top surface of the mask.

B) Appellant argues that Okumura does not disclose annealing the dried solute after sequentially performing plural times the pattern material supply process, adherent liquid process, and drying process.

Okumura, in col 4, lines 35-53, discloses performing plural times pattern material supply process, adherent liquid process, as discussed in paragraph A) of section 5, and drying process i.e., a palladium layer is formed in the openings of the mask, and dried, and no adherent material is left behind on the mask, followed by a pattern material supply process of nickel that is formed in the openings of the mask, and dried. See paragraph I of Section 1. After all theses processes, an ashing step is performed that subjects the substrate and all the layers therein to a higher temperature i.e., it is annealed.

Section 6

Claims 6, 16, 17

A) Appellant argues that Okumura does not disclose an annealing process for annealing the dried solute after sequentially performing plural times the pattern material supply process and drying process.

This is addressed in paragraph B) of Section 5. After the formation of palladium in the openings, the palladium layer is no longer in the solution form, it is a solute, it is dried. Similarly, the nickel layer formed in the openings is no longer in the nickel sulfate solution form, it is a nickel layer in a solute form, it is a solid layer.

Section 7

Claim 7

A) Appellant argues that Okumura does not supply an electrically conductive liquid-pattern material.

This is addressed in Section 1, arguments F), and G), and in Section 3.

B) Appellant argues that the process of producing solid metal by electroless plating does not read on "solidifying the liquid-pattern material".

This is addressed in paragraph F) of Section 1.

C) Appellant argues that Okumura does not teach a solid material removal process for removing solidified elements of the liquid pattern material that adhered to the mask surface when the liquid pattern material was supplied to the pattern-forming openings.

Okumura, in col 2, lines 42-46, and in col 4, lines 34-56, discloses that the photoresist mask top surface is hydrophobicized prior to forming the liquid or solution in the openings, and then the substrate with the resist mask is completely immersed in the solution viz., the palladium chloride solution. The palladium chloride solution includes a solute and a solvent i.e., the solution is applied onto to the entire surface of the substrate and that includes the top surface of the mask, wherein the solvent and solute (solution) is applied on to the mask's top surface. However, the material (solute or solvent i.e., solid or liquid) attempting to adhere and/or nucleate on the top surface of the mask during the entire time of immersion is repelled or dissipated into the tank of solution holder, i. e., the adherent solute or solvent or both is removed from the top surface of the mask. Similarly, a nickel layer is also supplied and dried in the openings, and any material (solute or solvent) adhered or attempted to adhere on the top surface of the mask are repelled or dissipated into the solution (i.e., removed), as discussed above.

Section 8

Claim 8

A) Appellant argues that Okumura does not teach a drying process to produce solute by evaporation and a solid material removal process for removing solids that adhered to the mask surface.

Drying by evaporation is addressed in paragraph A) of Section 3, and solid material removal process is addressed in paragraph C) of Section 7. Also Claim 8, does not recite a drying process to produce a solute by evaporation, it recites,

8. A pattern forming method comprising:

a mask forming process for forming a mask having pattern-forming openings on a workpiece surface;

a pattern material supplying process for supplying a liquid-pattern material to the mask openings;

a drying process for drying by evaporating solvent from the liquid-pattern material in the pattern-forming openings;

a solid-material removal process for removing dried solids of the liquid-pattern material that adhered to the mask surface when the liquid-pattern material was supplied to the pattern-forming openings;

an annealing process for annealing the dried solute after sequentially performing plural times the pattern material supply process, drying process, solid-material removal process; and

a mask removal process for removing the mask from the workpiece.

"a drying process for drying by evaporating solvent from the liquid-pattern material in the pattern-forming openings". This limitation does not suggest or read on a drying process that completely dried up the solvent in a liquid to only have a solute left behind.

B) Appellant argues that Okumura is silent on any annealing step for annealing dried solute produced from a liquid by evaporation using a drying process.

As addressed in paragraph A), of Section 8, the drying process does not read on a complete drying process that only leaves behind a solute. Also, see paragraph A) of Section 3, inregards to annealing. The plural steps are addressed in paragraph C) of Section 7.

Section 9

Claim 9

A) Appellant argues that Okumura does not teach a mask removal process after the sequentially performing plural times the pattern material supply process, drying process, solid-material removing process, and annealing process.

This is addressed in paragraph A) of Section 3, and paragraph C) of Section 7.

Section 10

Claim 19

A) Appellant argues that Okumura does not teach the combined step of supplying a liquid pattern material while also drying the liquid pattern material.

This is addressed in paragraph A) of Section 2.

B) Appellant argues that Okumura does not teach that liquid pattern material is solidified by a heat dry step to produce dried solute by evaporation.

Claim 19, recites, the following,

> 19. A pattern forming method comprising:
>
> a mask forming process for forming a mask having pattern-forming openings on a workpiece surface;
>
> a pattern material supplying process for supplying a liquid-pattern material to the pattern-forming openings while also drying the liquid-pattern material;
>
> an annealing process for annealing dried solute of the liquid-pattern material; and
>
> a process for removing the mask from the workpiece.

Claim 19, does not recite a heat dry step to produce a dried solute by evaporation.

C) Appellant argues that Okumura does not teach an annealing step for annealing the dried solute.

This is addressed in paragraph A) of Section 3.

Section 11

Claim 20

A) Appellant argues Okumura does not teach solidifying a liquid pattern material by producing dried solute by evaporation, followed by annealing the dried solute.

Claim 20 does not recite a solidifying process, nor does the drying process recite "producing a dried solute by evaporation". Also, this argument has been addressed in paragraph A) of Section 3, and also in paragraph A) and B) of Section 8.

Section 12

Claim 21

A) Appellant argues that Okumura does not teach an adherent liquid removal process prior to the solidifying step, does not teach a solidifying process consisting of a drying step for forming a dried solute by evaporation followed by an annealing step.

Adherent liquid removal step is addressed in paragraph A) of Section 5. Claim 21, does not recite a solidifying process. Claim 21 does not recite a solidifying process, nor does the drying process recite "producing a dried solute by evaporation". Claim 21, recites "a drying process for drying by evaporating solvent in from liquid-pattern material in the pattern-forming openings". Also, this argument has been addressed in paragraph A) of Section 3, and also in paragraph A) and B) of Section 8.

Section 13

Claim 22

A) Appellant argues that Okumura does not teach a method of solidifying a solvent by a first drying step to produce dried solute by evaporation followed by an annealing step for annealing the dried solute.

Claim 22 does not recite such a solidifying step of "solidifying a solvent by a first drying step to produce a solute by evaporation". This argument is addressed in paragraph A) of Section 3, and also in paragraph A) and B) of Section 8.

B) Appellant argues that Okumura does not teach a solid material removal process.

This argument is addressed in paragraph C of Section 7.

C) Appellant argues that Okumura does not teach a mask removal process after the repeated application of the pattern material supply process, drying process, and solid-material removal process.

This is addressed in paragraph A) of Section 3, and paragraph C) of Section 7.

(11) Related Proceeding(s) Appendix

No decision rendered by a court or the Board is identified by the examiner in the Related Appeals and Interferences section of this examiner's answer.

For the above reasons, it is believed that the rejections should be sustained.

Respectfully submitted,

dcd

Conferees:

/Romulo Delmendo/

Romulo Delmendo

Appeal Conferee

/Mark F. Huff/

Mark Huff

Supervisory Patent Examiner

Art Unit 1795